

Regional Changes in the Sea Ice Cover and Ice Production in the Antarctic

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Coastal polynyas around the Antarctic continent have been regarded as sea ice factories because of high ice production rates in these regions. The observation of a positive trend in the extent of Antarctic sea ice during the satellite era has been intriguing in light of the observed rapid decline of the ice extent in the Arctic. The results of analysis of the time series of passive microwave data indicate large regional variability with the trends being strongly positive in the Ross Sea, strongly negative in the Bellingshausen/Amundsen Seas and close to zero in the other regions. The atmospheric circulation in the Antarctic is controlled mainly by the Southern Annular Mode (SAM) and the marginal ice zone around the continent shows an alternating pattern of advance and retreat suggesting the presence of a propagating wave (called Antarctic Circumpolar Wave) around the circumpolar region. The results of analysis of the passive microwave data suggest that the positive trend in the Antarctic sea ice cover could be caused primarily by enhanced ice production in the Ross Sea that may be associated with more persistent and larger coastal polynyas in the region. Over the Ross Sea shelf, analysis of sea ice drift data from 1992 to 2008 yields a positive rate-of-increase in the net ice export of about 30,000 km² per year. For a characteristic ice thickness of 0.6 m, this yields a volume transport of about 20 km³/year, which is almost identical, within error bars, to our estimate of the trend in ice production. In addition to the possibility of changes in SAM, modeling studies have also indicated that the ozone hole may have a role in that it causes the deepening of the lows in the western Antarctic region thereby causing strong winds to occur off the Ross-ice shelf.